*भारतीय मानक*
*Indian Standard*

**IS 233 (Part 2) : 2021**

# वस्त्रादि — कपास रेशों की लंबाई प्राचलों के निर्धारण के लिए विधियां

## भाग 2 कटाई और वज़न विधि द्वारा रेशे की औसत लंबाई का अनुमान

*( दूसरा पुनरीक्षण )*

# Textiles — Methods for Determination of Length Parameters of Cotton Fibres

## Part 2 Estimation of Length and Length Distribution by the Array Method

*( Second Revision )*

ICS 59.060.10

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**November 2021** **Price Group 3**

Physical Methods of Tests Sectional Committee, TXD 01

## FOREWORD

This Indian Standard (Part 2) (Second Revision) was adopted by the Bureau of Indian Standards, after the draft finalized by the Physical Methods of Tests Sectional Committee had been approved by the Textiles Division Council.

This standard was first published in four parts in 1954 which covered methods for determination of various length parameters of cotton fibres using Ball (Sledge) Sorter Method, Ahmad-Nanjundayya Stapling Apparatus Method and Baer (Comb) Sorter Method. This standard was subsequently revised in 1978 to include two more methods (Part 5 and Part 6) namely, Thickness Scanning Method (Uster Stapling Apparatus) and Optical Scanning Method (Digital Fibrograph). Later in year 1989 through an amendment No. 2, Ball (Sledge) Sorter Method (Part 3) and Ahmad-Nanjundayya Stapling Apparatus Method (Part 4) were deleted as these methods are not used commercially and accordingly, Part 5 and Part 6 were re-designated as Part 3 and Part 4 respectively.

This standard has been revised again to incorporate the following major changes:

a) Amendments issued have been incorporated; and
b) References to Indian Standards have been updated.

This Indian Standard has been published in four parts. The other parts in the series are:

Part 1 General.
Part 3 Estimation of length and length distribution by the thickness scanning method.
Part 4 Estimation of length, uniformity ratio and uniformity index by the optical scanning method.

The fibre length of cotton is directly related to its spinning performance; in general, longer cottons can be spun to finer counts. The method of estimating fibre length or ‘staple’ of cotton used in the trade has long been accepted to be liable to considerable subjective and personal errors, and the need for accurate methods of determining the mean fibre length of cotton and the proportion by weight of fibres of different length grades in cotton has long been recognized.

The composition of the Committee responsible for the formulation of this standard is given in Annex A.

In reporting the result of a test or analysis made in accordance with this standard, if the final value, observed or calculated, is to be rounded off, it shall be done in accordance with IS 2 : 1960 ‘Rules for rounding off numerical values ( *revised* )’.

# *Indian Standard*

# TEXTILES — METHODS FOR DETERMINATION OF LENGTH PARAMETERS OF COTTON FIBRES

## PART 2 ESTIMATION OF LENGTH AND LENGTH DISTRIBUTION BY THE ARRAY METHOD

*( Second Revision )*

## 1 SCOPE

This standard (Part 2) prescribes a method for estimation of mean fibre length, effective length, percent short fibres and coefficient of variation of length by array method.

## 2 REFERENCES

The standard given below contains provisions which, through reference in this text, constitute provisions of this standard. At the time of publication, the edition indicated was valid. All standards are subject to revision, and parties to agreements based on this standard are encouraged to investigate the possibility of applying the most recent edition of this standard.

| *IS No.* | *Title* |
|---|---|
| 233 (Part 1) : 2021 | Textiles — Methods for determination of length parameters of cotton fibres : Part 1 General |

## 3 TERMS AND DEFINITIONS

For the purpose of this standard, the definitions given in IS 233 (Part 1) shall apply.

## 4 PRINCIPLE

A numerical sample of fibres is arranged in the form of an array in the descending order of length, and from a tracing of this array the effective length, mean length, percent short fibre and coefficient of variation of length are calculated.

## 5 APPARATUS

**5.1 Two Comb Sorters** — to prepare the fibre array, each comprising a bed of combs, an upper and a lower set-each spaced about 5 mm apart.

### 5.2 Accessories

As given below:

a) Fibre grip;
b) Teasing needle;
c) Rake to press in the fibres;
d) Velvet pad; and
e) Rectangular perspex scale (160 × 80 mm) marked in 5 mm squares.

## 6 PROCEDURE

### 6.1 Preparation of Aligned Tuft from the Test Sample (Using Two Comb Sorters)

**6.1.1** Place one sorter in a suitable position such that the first of the bottom combs which can be dropped in succession faces the operator. Lift the upper combs, and lay the representative sliver [*see* **5.1.1** of IS 233 (Part 1)] towards the right and across the lower bed of combs; about 20 to 30 mm of the sliver should project beyond the nearest comb. Press the sliver into the combs with the rake. Remove the projecting fibres with the grip, and square the sliver to obtain alignment with the first comb.

**6.1.2** Place the second sorter conveniently by the side of the first, but with the last of the bottom combs towards the operator. Lift the upper combs.

**6.1.3** Drop the first bottom comb of the first sorter so that about 5 mm of the squared end of the sliver projects out. Using the fibre grip, remove these fibres in short draws of full width, and place the tufts so drawn towards the left and across the bottom combs of the second sorter, such that the aligned ends of the tufts lie along the row of needles of the last bottom comb (nearest the operator). The fibres should be laid straight and at right angles to the comb rows. Press each tuft down into the combs with the rake. Drop the second bottom comb of the first sorter, and continue to transfer and pile up tufts on the second sorter until about 25 mg (or sufficient quantity) of fibres to prepare an array of about 100 to 150 mm length is built up.

**6.1.4** Lower the upper combs.

### 6.2 Preparation of the Fibre Array

**6.2.1** Turn the sorter round through 180 degrees.

**6.2.2** Drop sufficient number of lower combs and raise upper combs, wherever necessary, until the longest fibres project about 5 mm.

**6.2.3** Using the grip, pull out small tufts of successively shorter lengths. Comb and straighten fibres in each tuft, and lay them side by side on the velvet pad such that the free ends of the tufts lie along a straight base line. A continuous array of uniform density is produced by skillfully using the testing needle and a forefinger to arrange each tuft perpendicular to the base line and joining up with the previous one. Successive top and bottom combs are moved as shorter and shorter fibres are pulled out and joined into the pattern. The last few tufts should be very carefully arranged so that no short fibres are lost. It should also be ensured that the pattern is of uniform density throughout as the ultimate evaluation is based on this assumption.

**6.2.4** Trace the outline of the fibre array prepared on a sheet of translucent paper (*see* Fig. 1).

## 7 CALCULATION AND EXPRESSION OF RESULTS

**7.1** Calculate the following length parameters from the comb sorter diagram (*see* Fig. 1).

**7.1.1 Mean Length** — Determine the area of the comb sorter diagram using either the special transparent scale or a planimeter; divide the area expressed in square millimeters by the length of the base (mm) to obtain mean fibre length (mm).

**7.1.2 Maximum Length** — Determine the maximum length OA from the tracing.

**7.1.3 Effective Length** — Make geometric constructions as shown in Fig. 1 as follows:

a) Halve the maximum length OA at Q and draw a line parallel to the base through Q to cut the curve at P’; drop a perpendicular from P’ to meet the base line at P.
b) Mark off OK = OP/4 and erect a perpendicular KK’ to cut the curve at K’.
c) HaIve KK’ at S and draw a parallel line to the base through S to cut the curve at R’; drop a perpendicular from R’ to meet the base line at R.
d) Mark off OL = OR/4 and erect a perpendicular LL’ cutting the curve at L’. Effective length is the length represented by LL’.

**7.1.4 Upper Quartile Length** — Mark off OU = OB/4 and erect a perpendicular UU’ to cut the curve at U’. UU’ is equal to the upper quartile length.

**7.1.5 Percent Short Fibres** — Percent short fibre equals $\frac{RB}{OB}\times 100$ where OB is the total length of the diagram.

**7.1.6 Fibre Length Distribution** — Divide the comb sorter diagram into length groups of 4 mm interval (*see* Fig. 2). An improvised scale as shown in Fig. 3 can facilitate the marking of group limits; place the comb sorter tracing over the scale with the base line coinciding with the zero line, and mark off the points where the curve intersects the parallel lines. Drop perpendiculars to the base line from the marked points (*see* Fig. 2) and record the distances along the base in a tabular form as given in Table 1. Calculate the mean length and coefficient of variation of length as given in Table 1.

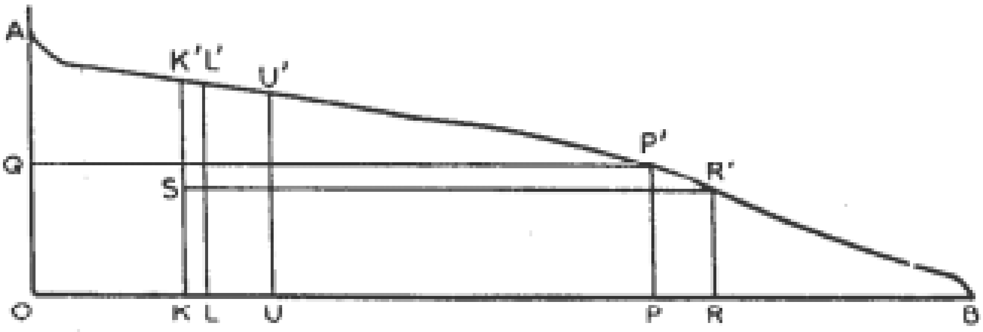

FIG. 1 COMB SORTER DIAGRAM

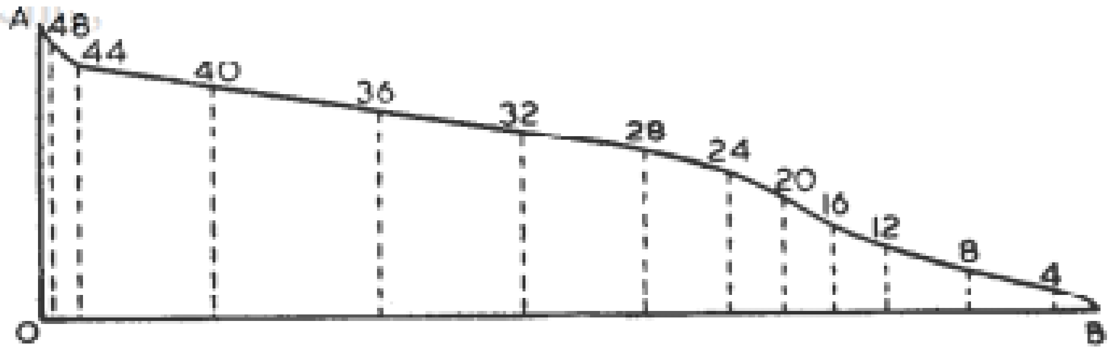

Fig. 2 Comb Sorter Diagram

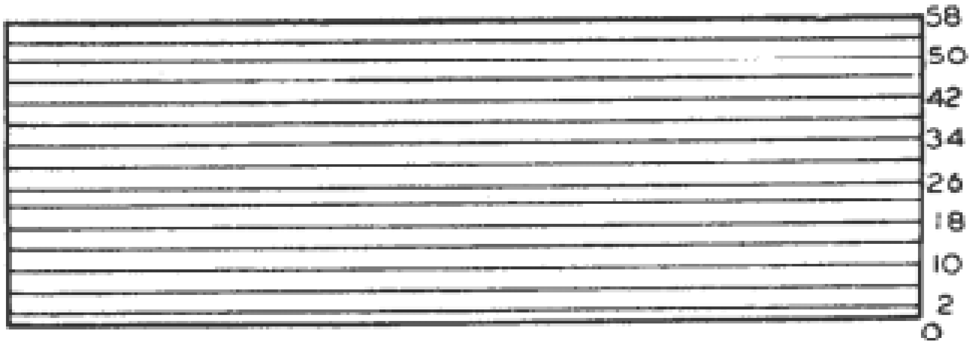

Fig. 3 Scale

**Table 1 Length Frequency Data From Comb Sorter Diagram**

( *Clause* 7.1.6 )

| Lower Group Limit<br>(1) | Group Length $li$<br>(2) | Distance Along Base<br>(3) | Relative Group Frequency $fi^1$<br>(4) | Percentage Group Frequency $fi$<br>(5) | $fi\ li$<br>(6) | $fi\ li^2$<br>(7) |
|---|---|---|---|---|---|---|
| mm | mm | mm | | | | |
| 48 | 50 | 1 | 1 | 0.6 | 30.0 | 1 500.0 |
| 44 | 46 | 6 | 5 | 2.8 | 128.8 | 5 924.8 |
| 40 | 42 | 29 | 23 | 12.8 | 537.6 | 22 579.2 |
| 36 | 38 | 58 | 29 | 16.2 | 615.6 | 23 392.8 |
| 32 | 34 | 82 | 24 | 13.4 | 455.6 | 15 490.4 |
| 28 | 30 | 103 | 21 | 11.7 | 351.0 | 10 530.0 |
| 24 | 26 | 118 | 15 | 8.4 | 218.4 | 5 678.4 |
| 20 | 22 | 127 | 9 | 5.0 | 110.0 | 2 420.0 |
| 16 | 18 | 135 | 8 | 4.5 | 81.0 | 1 458.0 |
| 12 | 14 | 144 | 9 | 5.0 | 70.0 | 980.0 |
| 8 | 10 | 158 | 14 | 7.8 | 78.0 | 780.0 |
| 4 | 6 | 171 | 13 | 7.3 | 43.8 | 262.8 |
| 0 | 2 | 179 | 8 | 4.5 | 9.0 | 18.0 |
| | | | $\sum fi^1 = 179$ | $\sum fi = 100.0$ | $\sum fi\ li = 2728.8$ | $\sum fi\ li^2 = 91014.4$ |

$$\text{Mean Length} = \frac{\sum fi\ li}{\sum fi} = \frac{2728.8}{100} = 27.3\ mm$$

$$Variance = \frac{\sum fi\ li^2 - \frac{(\sum fi\ \ li)^2}{\sum fi}}{\sum fi} =$$

$$\frac{(91014.4 - 74463.5)}{100} = 165.5$$

Standard deviation (σ) = $\sqrt{variance} = \sqrt{165.5} = 12.9$

Coefficient of variation (CV) =

$$\frac{\sigma}{Mean\ length} \times 100 = \frac{12.9}{27.3} \times 100 = 47.2 \text{ percent}$$

## 8 REPORT

**8.1** The report shall include the following information:

a) Mean length in mm (rounded off to one decimal place);

b) Effective length in mm (rounded off to one decimal place);

c) Upper quartile length;

d) Percent short fibres (rounded off to two significant figures); and

e) Coefficient of variation of length (rounded off to two significant figures).

# ANNEX A

( *Foreword* )

## COMMITTEE COMPOSITION

Physical Methods of Test Sectional Committee, TXD 01

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| ICAR-Central Institute for Research on Cotton Technology, Mumbai | Dr Pradeep Mandhyan (***Chairman)*** |
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| Indian Institute of Technology, New Delhi | Prof R. S. Rengasamy<br>Prof Apurba Das (*Alternate*) |
| Indian Jute Industries Research Association, Kolkata | Ms Saumita Choudhury<br>Shri D. P. Gon (*Alternate*) |
| Indian Jute Mills Association, Kolkata | Shri S. K. Chandra<br>Shri J. K. Behera (*Alternate* I)<br>Shri Rama Shankar Upadhyay (*Alternate* II) |
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| SGS India Pvt Ltd, Chennai | Dr Karthikeyan K.<br>Shrimati Anitha Jeyaraj (*Alternate*) |
| Testtex India Laboratories Pvt Ltd, Mumbai | Shrimati Meeta Shingala<br>Shri Mahesh Sharma (*Alternate*) |
| Texanlab Laboratories Pvt Ltd, Navi Mumbai | Shri Harit Sardana<br>Shri Vivek Patil (*Alternate*) |
| Textiles Committee, Mumbai | Shri Kartikay Dhanda<br>Dr P. Ravichandran (*Alternate*) |

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This Indian Standard has been developed from Doc No.: TXD 01 (16274).

## Amendments Issued Since Publication

| Amend No. | Date of Issue | Text Affected |
|---|---|---|
| | | |
| | | |
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Published by BIS, New Delhi